Globally Deployable Mobile Corrosion Repair Facilities (MCRF)

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Abstract

The cost of corrosion across the U.S. Department of Defense (DoD) exceeds $20 billion annually\(^1\), further increased by the non-monetary cost of reduced readiness levels. In addition to the costs of corrosion remediation, significant additional funds are depleted transporting tens of thousands of corrosion laden assets to depots and off base repair facilities, sometimes shipping assets half way around the world. Cost reduction efforts must include a program of preventive measures and remediation to correct corrosion formation throughout the useful life of an asset to yield a significantly longer life expectancy and reduce long-term maintenance and replacement costs.

An ever-increasing need exists for highly mobile and highly effective temporary facilities to remediate asset corrosion, reduce the DoD’s monetary costs, and to increase the readiness of vehicle deployment. Mobile Corrosion Repair Facilities (MCRF) are contractor owned mobile maintenance facilities that are deployed to military locations around the world for durations ranging from weeks to years. They consist of temporary building structures that may be erected and be fully operational within 10 days. MCRF capabilities include corrosion remediation, military and CARC repaint, and reduction of future corrosion of assets. Throughput is defined by customer needs and can exceed 100 vehicles per month. Assets remain on-base and always in the commander’s control, eliminating the cost of transportation to the off-site depot facilities while increasing readiness.

Notable MCRFs are self-sustaining deployable facilities that include paint preparation booths, paint spray booths, Expeditionary Vehicle Wash Systems (EVWS) and solar power generation for off-grid or remote locations. When services are completed, the MCRF is disassembled and re-deployed to alternative locations leaving no footprint left behind.

The DoD supports a number of low-risk, high-payoff technologies for improving the service life and reducing maintenance costs which yields a 16:1 return on investment\(^2\). The latest U.S. Marine Corps (USMC) Corrosion Prevention and Control (CPAC) statistics of corrosion services which utilizes MCRF services yield a significantly higher 23:1 return on investment dollars.
The Problem

A detailed and thorough corrosion control plan is essential to ensure sustainment of vital DoD assets. The U.S. Government spends between $19 and $23 billion (US) annually for corrosion services throughout the DoD. Starting in 2007, the estimated cost of corrosion within the U.S. DoD was $22 Billion annually and rose to $23 Billion in 2015. In 2018, the estimated corrosion costs had declined to $19 billion which may be attributed to the culmination of new manufacturing technologies, anti-corrosion materials, next-generation paints and coatings, and stronger corrosion control measures such as Mobile Corrosion Repair Facilities.

The US DoD has declared a mission to implement a standardized program for substantially improved strategies, objectives and processes to prevent, detect and treat corrosion and its effects on military equipment. This mission coincides with US Congressional directives and the US Government Accountability Office (GAO) recommendations cited in the GAO-03-753 report in which the ultimate objective is to reduce the negative operational effects and associated total ownership cost of military equipment and infrastructure.

Traditionally, corrosion control and repair procedures within the U.S. DoD is performed through the use of remote military repair depots, off-site corrosion repair facilities (CRF), and commercial facilities; all of which are typically located miles away from the military installations. Though some military installations may have limited on-site corrosion repair, many military installations tend to transport their corroded assets to off-site locations for repair. In addition to the costs of the off-site corrosion remediation, these military installations must also pay to transport the equipment and supply the personnel and extra vehicles to deliver the equipment to the CRF. These costs are exasperated by extended transportation routes to avoid low bridge overpasses, weight restrictions on local roads, reduced military readiness levels, and reduced training equipment due to those assets being off-site for repair.

Military leaders are forced to allocate much needed personnel to perform corrosion control to the best of their ability which reassigned the warfighter away from their normal duties. Likewise, these personnel are tasked with repairing vehicles and assets to be mission-ready but are often not properly trained in effective Corrosion Prevention and Control procedures. In fact, the DoD does not have a formal Military Occupational Specialty (MOS) for the treatment of corrosion on ground equipment and vehicles.

Implementation of an MCRF provides a cost-effective way to perform corrosion control, with properly trained personnel, directly at each military location. The MCRF effectively decreases the assets’ out-of-service time and effectively increases combat readiness.
What is MCRF

A Mobile Corrosion Repair Facility (MCRF) is an independently owned, government-hired, 100% transportable, rapidly deployable, corrosion repair facility used to perform corrosion remediation and repaint. These systems are fully scalable to meet throughput demands which can be as few as 2 or 3 assets per month or as many as 100 or more assets per month. The MCRF is erected at the customer’s location and consists of a series of tension shelters. Although scalable to meet military throughput requirements and demands, the configuration typically consists of a three-shelter system: Preparation Shelter, Paint Shelter and Cure Shelter.

Figure 1: MCRF layout in National Training Center, Fort Irwin, CA (USA)

MCRF Capabilities

The first step in the MCRF system is the Preparation Shelter where corrosion removal and surface preparation are performed. Next, coating application is performed within the Paint Shelter and finally, the Cure Shelter provides a climate-controlled environment for paints and coatings to properly cure.

Capabilities within the Preparation Shelter include steam cleaning and pressure washing of the corroded assets prior to corrosion removal, followed by mechanical descaling of heavy corrosion, abrasive blasting, mechanical sanding, and manual cleaning of the corroded areas. All areas of the asset that will be provided with restorative paint and coating applications are additionally scuff-sanded and cleaned to accept the new coatings.

Capabilities within the Paint Shelter include substrate pretreatment applications to restore the zinc and phosphate layers, metallization or plasma spray treatments as necessary, military-specification corrosion inhibiting primer systems, and military-specification top coats that include both single-color applications and camouflage coatings according to technical manuals and contractual requirements. Additional services include tie coat application, anti-chip undercarriage coatings,
anti-abrasion coatings, non-slip/skid coatings upon walking surfaces and steps, and spray-applied military bedliner systems in cargo holds, trailer surfaces, and truck beds.

Capabilities within the Cure Shelter include a climate-controlled environment with ventilation to allow coatings to properly cure within specification guidelines. Significant light sources within the Cure Shelter are provided to allow quality control inspections and checkpoints to continue uninterrupted during the cure process. Upon final inspection, the completed asset is returned to the military motor pool for operational use.

MCRFs are *temporary structures* which are used for short-term durations. Because these structures are *temporary*, building permits are usually not required for set-up. They are specifically designed to be highly mobile facilities which are easily and quickly deployable anywhere in the world. Typical MCRF mobilization takes between 10-15 days to be erected and fully functional, while demobilization is achieved within approximately 7-10 days. The cost benefit of these systems allows for multiple MCRFs to be deployed and in operation around the world simultaneously to provide increased readiness levels and decreased costs. The temporary nature of these systems eliminates the costs associated with brick and mortar constructions and allow for reconfiguration as requirements change.

MCRFs have been approved and contracted by the US Marine Corps, US Army, and US Air Force on a global scale. These facilities are 100% self-sufficient and can operate independently of local grid power using solar energy or fueled generators. Each facility is climate controlled with integrated air filtration equipment and houses all corrosion remediation and repaint tools, equipment, and supplies.

MCRF set-up locations are achievable upon any solid ground, preferably concrete, asphalt, or crushed stone. The typical three-shelter system requires 22500 FT² (2090 m²) of space which is easily accommodated within a secondary parking lot.

![Figure 2 MCRF facility deployed in Dülmen, Germany](image-url)
MCRF personnel and technicians are fully trained in safety regulations as defined by the US Department of Labor Occupational Safety and Health administration (OSHA) and/or local authorities. Continued training is performed weekly at each MCRF facility, or as required by the military installation or contractual requirements.

Environmental requirements are satisfied through a formal permitting process with local, state, and installation agencies. All permit applications and acquisitions are fulfilled by the MCRF. Hazardous waste disposal is minimal, though when accumulated, proper disposal is contracted through hazmat facilities or the local military installation processes, following local regulations and is coordinated by the MCRF.

Staffing levels for MCRF depend on several variables with the desired throughput being the most significant staffing factor. Standard staffing for an MCRF consists of Site Manager, Painter, and Prep Technician. Typically, the ratio of prep technicians to painters is 3:1. MCRF is staffed with 2-3 subject matter experts (SME) and the balance of the staff is augmented with locally hired technicians. The higher the desired throughput of vehicles and equipment, the larger the staff.

**Benefits of MCRF**

Vehicles and support equipment are serviced at all stages of corrosive decay thus greatly extending the service life of the asset. The benefits of having an MCRF directly on a military site is to maintain an increased combat readiness while saving costs. Simply stated, the assets never leave the military installation grounds and remain fully accessible by commanders both before servicing and directly after servicing; increased readiness levels, decreased cost.

On-site MCRF capabilities result in the complete elimination of transportation costs. Assets are repaired on-location, oftentimes in close proximity to the motor pool. This proximity to vehicle storage and motor pools eliminates all costs associated with transporting assets to off-site repair facilities and depots. A secondary benefit of eliminating off-site transport of assets relates to the duration of their current Corrosion Category Code. When corrosion remediation occurs as quickly as possible, such as with on-site remediation, it results in fewer labor hours for repairs which further results in lower costs to the Government.

For example, the 4th Marine Division, 14th Marine Regiment located at the Naval Air Station (NAS) Fort Worth Joint Reserve Base (JRB) in Fort Worth, Texas has 564 vehicles or pieces of equipment in their possession. According to recent nationwide flatbed double drop style trailer shipping price quotations, the shipping cost per mile for military assets is approximately $4 per mile ($2.50 per km).

Within this example, the nearest intermediate level repair facility to NAS Fort Worth JRB is 1,295 miles (2084 km) away and located at Marine Corps Base (MCB) Camp Lejeune in North Carolina. Therefore, the cost to send one flatbed double drop style trailer, round trip, from NAS Fort Worth JRB to MCB Camp Lejeune is estimated to cost $10,360.
Double drop style trailers can accommodate vehicles up to 28 feet (8.5m) in length. Of the 564 vehicles owned by the 14th Marine Regiment located in NAS Fort Worth JRB, 186 vehicles are so large that they will need dedicated double drop style trailers for transportation, or one military vehicle per tractor trailer. The round-trip cost to send only these 186 large vehicles to MCB Camp Lejeune for intermediate level corrosion repair is estimated to cost $1,926,960. Additional to the shipping costs, collected data reveals an average corrosion service cost of $9,500 (US) for similarly sized vehicles which would yield a net cost of $1,768,000 (US) for corrosion services. Combined estimated costs for ground transportation and corrosion services collectively would be approximately $3,693,960 (US).

![Graph showing transportation costs increase as quantity of vehicles shipped increases](image)

Figure 3: Transportation costs increase as quantity of vehicles shipped increases

As the quantity of vehicles that require repair are shipped to off-site repair facilities increases, the overall shipment costs increase incrementally.

Inverse to the previous example of shipping and repair costs, NAS Fort Worth JRB has, in fact, utilized MCRF services at their location, thus saving almost $2,000,000 of estimated shipping costs. Based upon historical refurbishment cost data collected from multiple MCRF’s located at NAS Fort Worth JRB, the repair cost for similarly sized large assets is approximately $9,000-$10,000 per asset. The cost includes all labor, materials, consumables, management and other direct costs (ODC) for repair services conducted at the on-site MCRF. Because this refurbishment required no transportation of assets, NAS has potentially saved $1,926,960 which could then be reallocated to additional corrosion services or other operational requirements.

In this example, the $1,926,960 that was saved on shipping costs could result in an additional 226 assets being fully serviced for corrosion repair through the very same MCRF; increasing readiness
level while decreasing costs. Additionally, in many cases, the asset can be repaired and returned to operational status before it even reaches the off site CRF through traditional methods. Because there are no additional transportation costs there is no need for personnel to support the transportation which equates to additional cost savings. Fewer personnel performing transportation means more personnel dedicated to their normal duties.

The US Military greatly supports their surrounding communities, and MCRFs follow that example. Painting supplies, tools, and equipment are sourced from local businesses; the consumable costs associated with operating an MCRF can range from $2,500 to $5,000 per month all of which is procured through local businesses. Additionally, the MCRF employees utilize local hotels, apartments, and restaurants, while the employees support local shopping. The MCRF experts hire and train local employees to support the corrosion remediation and painting process which makes every employee an asset to the MCRF and to the local economy.

The US DoD has also utilized the MCRF to assist the traditional CRF with backlogs, additional mission requirements and during phases of re-construction and repair of the buildings. This enhancement to the traditional CRF has allowed the US DoD to complete the required throughput without the additional cost of additional shifts, overtime, hiring, training and eventually laying off personnel once requirements are met. MCRF have been used in this capacity for periods as little as 6 months to 4 years.

**Conclusions**

The cost of corrosion across the U.S. Department of Defense (DoD) exceeds $20 billion annually and results in reduced readiness levels. In addition to the costs of corrosion remediation, significant costs are consumed through the transport of tens of thousands of corrosion laden assets to depot and off base repair facilities. Implementation of Mobile Corrosion Repair Facilities has proven to provide cost-effective corrosion remediation while eliminating transportation costs associated with shipping assets to repair depots. Combat readiness levels remain high while all assets remain usable during the repair process.

The cost of corrosion is exorbitant, however, the services of MCRF can support your corrosion and sustainment programs to reduce your costs and provide an excellent return on your investment.

Cost reduction efforts that include a program of preventive measures and remediation to correct corrosion formation throughout the useful life of an asset will ultimately yield significantly higher life expectancies and reduce long-term maintenance and replacement costs – as shown by MCRF operations within the US Marine Corps, as much as a 23:1 ROI is achievable.
References


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